AFRICA TRADE and DEVELOPMENT

Vol. 2 No. 1 JANUARY 1960 One Shilling

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KARIBA HYDRO-ELECTRIC PROJECT

SOUTH AFRICAN RAILWAYS EXPANSION PROGRAMME

Western Nigerian Production Development Board

Business Opportunities Trade Agreements

General Developments

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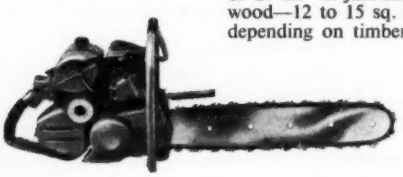

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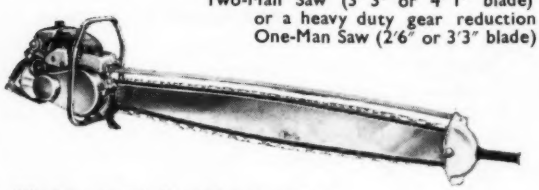

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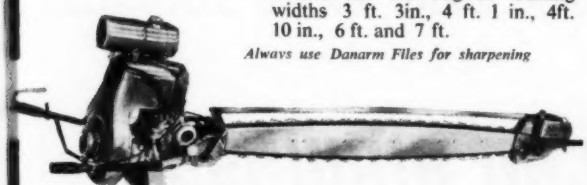

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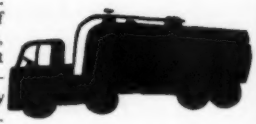

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Published alternate months
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AFRICA TRADE *and* DEVELOPMENT

58 PADDINGTON STREET, LONDON, W.1

Editor : E. M. BIRD

published monthly

Distribution Manager : B. M. Everitt

ANNUAL SUBSCRIPTION : 10 Shillings (2/- Postage)

January 1960

The South African Railways Modernization and Expansion Programme

THE £700-MILLION modernization and expansion programme of the South African Railways and its associated services, which included the doubling of the Natal and Orange Free State main lines, the extension of electric traction, the introduction of diesel-electric traction, the provision of new and additional rolling stock, harbour improvements and the expansion of the road transport and airways services has very nearly reached its goal, and only comparatively minor works still remain to be completed.

Goods handling, mechanization in goods yards, harbours, marshalling yards and at stations, the improvement of track capacity and the replacement of worn-out assets are among other matters which received attention.

South Africa has large reserves of coal, and the South African Railways has continued to use steam power and steam-generated electricity as its main sources of tractive effort. The locomotive picture is, however, changing and in common with most railways, diesel traction has been introduced and is being extended while track electrification is being extended to sections where the density of traffic gives this system an economic advantage over other forms of traction.

Diesel traction is being introduced on sections such as in South West Africa which are far removed from the coalfields and where water shortages are experienced. Steam traction continues to be used in other areas.

Doubling of Lines

The doubling of the Natal main line from Durban to Ladysmith, a distance of 185 miles, at a cost of £11 million will increase the carrying capacity of the line to 45,000 tons a day which is more than twice that of the old line.

The work is complete except for a short section between Boughton and Cedara where twin tunnels, each 3¾ miles long, are under construction. It is expected that the line will be in service by March 1960. The Orange Free State main line was doubled from Vereeniging to Bloemfontein at a cost of £8 million and the carrying capacity increased from 20,000 to 40,000 tons a day.

Electric Traction

Electric traction was first introduced by the South African Railways in 1926. At the end of the 1953/54 financial year, 859 route miles, representing 1,748 single track miles had been electrified. A further 438 track miles were added during the five-year period ending March 1959. On completion of the present electrification programme the total electrified track mileage will be 2,981 and the electric working of trains will then be possible from Cape Town to Beaufort West (339 miles), Durban to Volksrust (321) and Harrismith (263), Witbank to Klerksdorp (200) and from Pretoria to Kroonstad (160 miles).

At the end of the 1958/59 financial year the South African Railways had 392 electric locomotives with a total tractive force of 10,451,080 lb, and 1,396 suburban electric motor-coaches, driving trailers and plain trailers in service and operated four electric locomotive running sheds at Salt River in the Cape, Umbilo and Danskraal in Natal and Braamfontein (Johannesburg).

C.T.C. and Remote Control

One of the most interesting aspects of the modernization and expansion programme was the almost complete resignalling of the South African Railways network, and in order to increase the capacity of certain single lines it was decided to introduce Centralized Traffic Control and Remote Control. C.T.C. is being installed at a cost of almost £8½ million over sections totalling 644 miles and comprising 135 stations. Remote Control is already in operation on the Klerksdorp-De Aar line where all interloops on a continuous section of 338 miles are remote-controlled and good progress is being made with installation work on other sections including new lines to the Bantu townships.

Diesel Traction

Diesel traction was introduced by the South African Railways to ease the engine power shortage in respect of coal traffic in Transvaal and for shunting work on the Witwaters-

rand. The first 45 diesel-electric locomotives have been in service for some time on heavy haulage from the Witbank area to Klerksdorp and Kroonstad and also on some main line passenger trains while seven diesel-hydraulic locomotives were recently placed in service. Diesel traction will, in terms of present intensions be used mainly in South West Africa where dieselization was decided on because of the scarcity of water and recurring droughts and to eliminate the expensive transport of coal for locomotive purposes from the Transvaal. The Railways Administration has ordered 115 diesel-electric locomotives of 1,980 hp at a total cost of approximately £10 million and they will be placed in service as soon as work is finished on the broadening of the South West Africa narrow gauge lines, from 2 ft. to the standard South African Railways gauge of 3 ft. 6 in.

Rolling Stock

The legacy of the war in the shape of worn-out trucks and depleted tractive effort has now practically disappeared. During the past five years the total tonnage of goods carried advanced by 5,831,784 from 71,172,652 to 77,004,436, the number of goods wagons in service increased from 120,940 with a carrying capacity of 2,415,341 tons to 146,778 with a carrying capacity of 2,953,077 tons, and the locomotive tractive force advanced from 87,710,010 lb to 104,606,170 lb.

Harbours

The harbours of South Africa also received special attention with expanding needs and improved service the dominating factors. An extensive programme of mechanization of harbour goods handling was undertaken, and today the harbours are able to handle a greater tonnage than is currently on offer. The present equipment includes 249 fork-lift trucks (with 17 more on order), 8 straddle-trucks, 5 side-loading trucks, 24 mobile cranes, 4 belt-conveyors and 17,800 steel pallets. The harbour crane position has also been reviewed and the present programme is to supplement existing crane power at all the ports. Durban will get another 25, East London 5, Port Elizabeth 15, Cape Town 8, and Walvis Bay (S W Africa) 10, a total of 63 new cranes varying in lifting capacity from four to 15 tons.

During the financial year ending 31 March 1959 the Union ports handled 13,300 vessels and 17,431,956 tons of cargo.

Road Transport Service

The Road Transport Services operate over 30,074 route miles and during the 1959 financial year carried 2½ million tons of goods traffic, almost 10 million passengers and nearly 3 million gallons of cream.

The total capital and betterment expenditure on road transport services during the past five years amounted to £612,746 and railway road transport is rapidly being brought into line with the most modern developments in the matter of luxury passenger buses, goods road vehicles for special purposes and heavy duty equipment.

Airways

South African Airways is operated by the South African Railways Administration. The most important development in this transport arm during the past five years was the placing in service of the new Vickers Viscount turbo-prop aircraft which were purchased for domestic and regional services at a cost of £2.9 million.

An order has also been placed for three Boeing jet airliners, at a cost of approximately £6 million. During the past financial year, South African Airways carried 242,562 passengers on domestic services, 25,967 on regional services and 26,705 passengers in partnership with the BOAC on the trunk service between Johannesburg and Europe.

GENERAL DEVELOPMENTS

South African Production

A record cotton crop has been forecast by the South African Division of Economics and Markets for the 1958/59 season. The crop, including Swaziland's yield, is estimated at 37,000 bales (of 500 lb each) of lint, compared with 26,500 bales in the previous season. The requirements of the Union's textile industry this year are expected to be about 80,000 bales. There has been a notable increase in butter production in recent years, from 75 million lb in 1951 to 92.6 million lb in 1958. The 1958 figure was equal to 98 per cent of the national consumption and owing to fairly large purchases from South-West Africa, some exports to neighbouring territories and in the form of ship's stores have been made. According to the annual report of the Doornkop Sugar Company, the sugar industry in Natal is now worth about £113 million. The value of land and crops is put at about £70 million, and the replacement value of other assets at about £43 million. It is estimated that, to satisfy domestic requirements and export quotas, sugar production will have to reach 1.5 million tons by 1970. The highest output so far was 1.1 million tons, in 1958.

Tenders for Audio-visual Equipment (Sudan)

The Ministry of Information, Khartoum has issued tenders for audio-visual equipment. These purchases will be financed by the International Co-operation Administration (ICA) of the United States. Tenders have also been issued for tape recorders, copying equipment, air-conditioners and air coolers.

Loan for a Bantu Firm

The Bantu Development Corporation has advanced its first loan to a Bantu commercial enterprise. The enterprise is the Vendaland Trading Company in the Northern Transvaal. Mr Schoeman said in a newspaper interview that the Corporation's investigating officers were studying many applications for assistance. Meanwhile general policy was being formulated, and next year the tempo of granting aid would be stepped up. A number of Bantu have already applied to invest money, and this type of investment is expected to provide a large proportion of the funds needed to finance Bantu industrial and commercial projects.

Perkins outboard motors for Africa

Perkins outboard motors are to be tested in West Africa on a regular basis in the near future. The production of the 6, 16 and 35 hp engines has begun at the newly established Walton factory, Peterborough, and it is expected, that these engines will find an important outlet in African countries, especially for the fishing industries.

Perkins Outboard Motors Ltd is a subsidiary of F. Perkins Ltd, Peterborough, who are probably the world's largest lightweight diesel engine manufacturers, whose largest plant—the Eastfield factory, Peterborough—is producing about 400 diesel engines a day, and next year will produce about 700 engines a day for vehicles, tractors, combines, boats and industrial equipment.

New Shipping Service (East Africa)

Seaford Shipping, a South African firm, and Kawaski Kisen Kaisha of Japan, are to introduce a new shipping service, which will be known as Africa Pacific Line. Six modern cargo ships will be in operation and will ply between ports on the West coasts of Canada and the USA and the East Coast of Africa.

Survey—African Agriculture

The Federal and Southern Rhodesia Governments are to spend £7,500 on a survey of African agriculture in Southern Rhodesia. The Director of the Central African Statistical Office, Dr. F. T. Russell, said in Salisbury on 9 November that the main purpose of the survey is to make estimates of crop yields in African areas for the 1959/60 season. He said that seven Europeans and eight hundred Africans would be required for the survey, while African demonstrators, co-ordinated by African Agricultural Supervisors, would carry out the survey in African reserves, a team of Europeans and three African field assistants would work among Africans on Crown land and those squatting on European farms.

South Africa agency (Transvaal)

Mr. R. J. Cole of R. J. Cole (Pty) Limited, Essanby House, Jeppe Street, Johannesburg, has informed the United Kingdom Trade Commissioner at Johannesburg that his firm are interested in obtaining new agencies for the Transvaal area for United Kingdom manufacturers of printed lines, medium priced tapestries, brocades etc.

R. J. Cole (Pty) Ltd who are an old established firm of manufacturers' representatives specializing in high quality soft furnishings and upholstery tapestries, already represent two United Kingdom manufacturers, one for period and modern tapestry and hand-embroidered suite materials and trimmings and the other for Terylene curtain nets. They have held the agency for tapestry etc since 1935. They have two sales staff (R. J. Cole himself and his wife) and the territory covered is the Transvaal only. The Johannesburg concern are considered to be a suitable connection for United Kingdom firms.

Manufacturers interested in this agency enquiry should write direct to Mr. R. J. Cole. It would be appreciated if, at the same time, they would notify the United Kingdom Trade Commissioner, PO Box 10101, Palace Buildings, 52 Pritchard Street, Johannesburg, that they have done so.

South African representative (Electrical)

Messrs Rivalland & Son (Pty) Ltd, 9 Fisher Street, Durban, have informed the United Kingdom Trade Commissioner at Durban that they would like to get in touch with United Kingdom manufacturers, who are not represented in the Union, of the following electronic components:

Transformers, LV and HV; Condensers electrolytic; Condensers paper; Condensers mica; Resistors wire wound; Resistors composition; Potentiometers wire wound; Potentiometers carbon; Condensers variable; Condensers variable miniature; Condensers variable differential; RF chokes; Chokes; Transformers audio output; Transformers interstage: Capacitators; Valve sockets; Valve (tubes)· Wafer switches; Toggle switches; Condensers variable slug.

Messrs Rivalland & Son (Pty) Ltd, are a well-known firm of manufacturers' representatives who were established in 1945. They represent a number of South African, United Kingdom and other overseas principals in respect of steel plates, bars and sections etc; steel wires; electric conduit tubing and fittings; electric cables, wire etc, water and gas pipes; nuts, screws and nails; drilling and grinding machines; engineering workshop tools and woodworking machinery. The head office of the company is in Durban and they have branches in Johannesburg and Cape Town and sub-agency arrangements in Port Elizabeth so that they can provide all-Union coverage. The Durban concern are considered to be a suitable connection for United Kingdom firms.

Manufacturers interested in this agency enquiry should write direct to Messrs Rivalland and Son (Pty) Ltd and notify the United Kingdom Trade Commissioner, 410 Union Building, Smith Street, Durban that they have done so.

Power Link-up (Kenya)

Many Kericho residents will have electric light for the first time shortly with the completion of the first stage of a scheme which, by early next year, will bring electric power to Kericho, Koru, Miwani and Kisumu, in Nyanza Province, Kenya. The scheme is costing East African Power and Lighting Company £500,000.

The link-up of current will benefit several industries along the route, including a large sugar factory at Miwani, tea factories in the Nandi area and industries at Kisumu which at present rely entirely on power from a local generating station.

Hungarian Power Plants for Ghana

Two engineers of the Ganz-Mávag Works of Budapest have spent two weeks in Ghana where they studied possibilities of utilizing the rivers for power production. The Hungarian experts have declared that in their opinion the rivers Dens and Praa are suitable for the construction of hydro-electric plants. Negotiations have started with a view to the building of two power stations.

Federation Trade balance

In the first nine months of the year the Federation had a favourable balance on visible trade of £35,000,000. Last year's figure for the period showed a £7,000,000 deficit. Imports for the period dropped to £111,000,000 from £123,000,000 in 1958. Exports increased from £111,000,000 at the end of September 1958—when the figure was still unaffected by the copper strike—to £141,000,000 in the same period this year. Gold exports were steady at £5,000,000. Provisional figures just released for September value imports at £12,600,000 and exports at £18,000,000, with an additional £600,000 from gold exports. In September 1958, imports totalled £11,900,000 and exports, including gold, only £11,600,000.

TRADE FAIRS

Textile Display in South Africa

United Kingdom textiles will be the theme of the display in the British Pavilion at the Rand Show in Johannesburg from 4/23 April 1960.

There will be an official exhibit with a composite display of fabrics on the ground floor while a number of individual firms will have stands on the mezzanine. The UK Pavilion, a permanent one first used for the 1959 Show, provides about 7,000 square feet of exhibition space.

The official exhibit is being organized by the Board of Trade with the co-operation of the Textile Promotion Consultative Committee, London. The display will incorporate fabrics supplied by The British Man-Made Fibres Federation; The Cotton Board; The Domestic Textiles Federation; The Federation of Lace and Embroidery Employers' Associations; The Furnishing Fabrics Federation; The Irish Linen Guild; The National Wool Textile Export Corporation and The Silk & Rayon Users' Association

The trade display on the mezzanine is being organized by the UK Trade Commissioner, Johannesburg, with the co-operation of the British Manufacturers and Representatives Association and of Mr. I. R. McLennan, a South African designer.

The Central African Trade Fair

The first Central African Trade Fair will be held in Bulawayo during May 1960. It aims at providing a regular focal point at which to show the progress of industry in the Federation, and its cultural and scientific achievements.

All information can be obtained through the General Manager, Central African Trade Fair, PO Box 3384, Bulawayo, S. Rhodesia (Tel: "Agrishow").

Publications Received

KARIBA—the struggle with the River God. By FRANK CLEMENTS (Methuen, 16s.).

In May 1960 the Kariba Dam will be officially opened and a great achievement will have been accomplished. In this extremely readable book Mr. Clements, himself a Rhodesian, describes the events which led up to the decision to construct a hydro-electric station on the site at Kariba and gives a history of the actual building.

Apart from the economic factors, such problems as race relations and the difficulties of animal evacuation from the advancing lake waters are included. There are 22 half-tone plates and two maps illustrating the various stages of the Kariba Dam, the floods of 1957 and 1958 and other relative events.

For those interested in this incredible piece of construction this book is highly recommended as a clear and interesting account.

E.M.B.

THE KARIBA HYDRO-ELE

by our Co (Sali

UNTIL ONLY A FEW YEARS AGO the Kariba gorge, deep in unexplored territory and lying many miles from the nearest road, was known only to the local tribes and to a few white hunters. Now it can be approached by roads driven through the bush, across hitherto impassable swamps, to the Kariba dam harnessing the mighty Zambezi river.

The first stage of the Kariba hydro-electric project will be opened in May 1960, and will involve an expenditure of £80.6 million. This money has been loaned from the following sources:

	£ *million*
World Bank	28.6
Copper mining companies (Rhodesia)	20.0
British South Africa, Co	4.0
Standard Bank of South Africa	2.0
Barclays Bank DCO	2.0
Federal Government of Rhodesia	6.0
Commonwealth Development Corporation	15.0
Commonwealth Development Finance Co	3.0

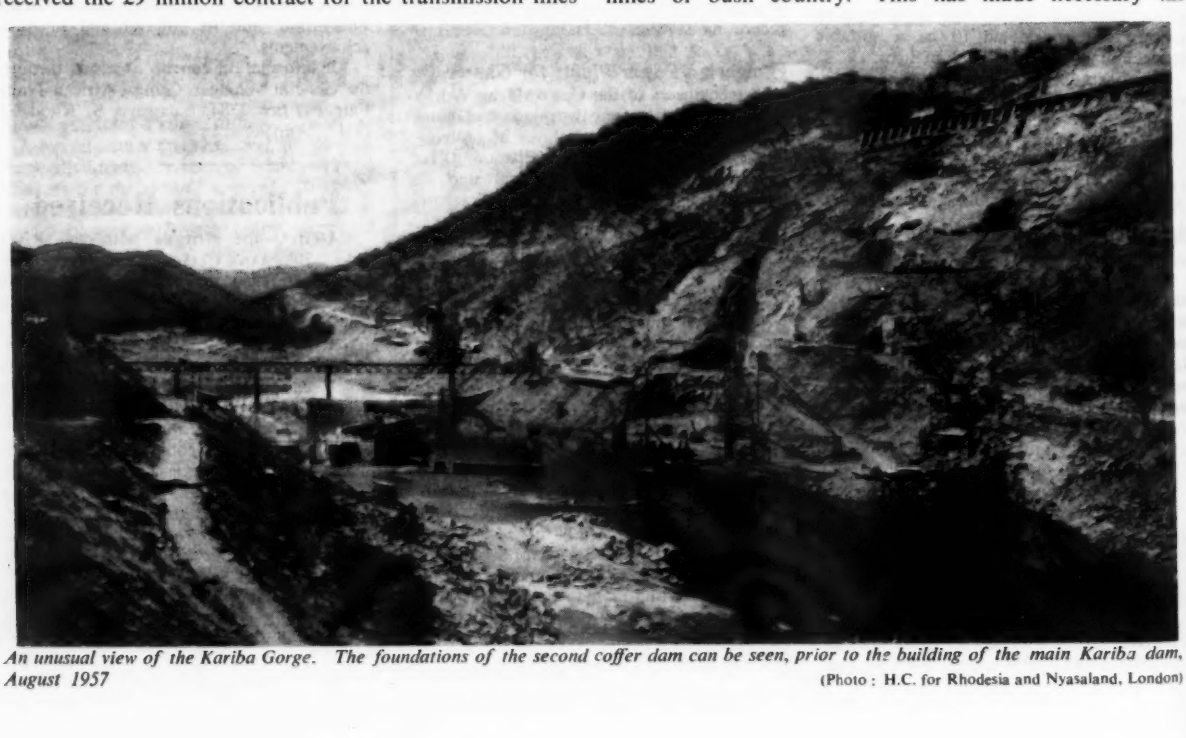
The second stage will cost a further £34 million for which the Rhodesian Federal Power Board has undertaken to find the money through surpluses, loans and other sources.

The main contract for the first stage, the actual construction of the dam, was awarded to an Italian firm, Impresit (Kariba) (Pvt) Ltd, formed by a group of independent Italian civil engineering companies for the purpose of constructing the dam. The value of this contract is over £25 million of which some £15 million would be used in the Federation of Rhodesia and Nyasaland for work and materials. The United Kingdom and the Federation received contracts worth £40.8 million, of which Britain supplied equipment of £19 million. The Federation also received the £9 million contract for the transmission lines to carry the power away from the dam, and British firms have supplied under this contract £4 million worth of goods.

Contracts for equipment have been awarded to the following United Kingdom firms: Boving and Co, Ltd £1,072,583; Metropolitan Vickers Electrical Export Co, Ltd £1,772,065; English Electric Co £662,500; Ferranti Ltd £1,333,200; Babcock and Wilcox £108,292; C. A. Parsons and Co £191,920; Cementation £1,593,780; Richard Costain £3,523,175; British Thomson-Houston Co, Ltd £2,121,141; British Insulated Callenders Cables £204,000; Markham Co £1,000,000. Smaller contracts were given to Herbert Morris, Ltd and A. Reyrolle and Co, Ltd.

The main dam rises 420 feet from the river bed and includes four spillway gates, 30 feet square, which will discharge into a pool immediately below the dam. Across the crest of the dam runs a road 1,900 feet long linking Northern and Southern Rhodesia. Over 150 miles of access roads have been built to carry heavy traffic, and a township to accomodate between 8/10,000 has risen on the slopes above the gorge.

Behind the dam is now rising the man-created lake stretching for 175 miles, roughly the distance between London and Exeter including the whole of the London area. It will be up to 20 miles across and will flood 2,000 square miles of bush country. This has made necessary the



An unusual view of the Kariba Gorge. The foundations of the second coffer dam can be seen, prior to the building of the main Kariba dam, August 1957

(Photo: H.C. for Rhodesia and Nyasaland, London)

YELECTRIC PROJECT

ur Co (Salisbury)

resettling of 50,000 Africans of the Batonka tribe who have been moved to new lands away from the areas affected by the rising waters. Many thousands of wild animals have also been driven from their usual habitat and while many have found their own way to safety, others have had to be rescued by teams of men organized for the purpose or have been caught by the rising waters and drowned.

Power from Kariba will bring increased prosperity to both Northern and Southern Rhodesia. In 1955 the total consumption of power by Salisbury, Bulawayo and the Copperbelt area which includes Ndola, amounted to 1,805 million kWh. By June 1971 the demand is expected to have risen to 7,007 million units, an annual compound rate of 8.2%. This figure is accepted as a justified estimate and was one of the ruling factors when the original decision was taken to built Kariba. However, it is important that the demand for power should come as soon as possible as the loans occured will be repaid to a great extent through the monies received for the sale of generated power.

There are to be two power stations hewn into the rock on the north and south banks of the river. The first station which has been built is on the south side, and contains six 140,000 bhp turbines each driving a 100-megawatt alternator. The generators, which will be coupled direct to the turbines have been designed for continous maximum output of 100,000 kW at 0.9 power factor, three-phase 50 cycles. They will be of the synchronous closed-air-circuit, water cooled type and of such a size that it was proved impossible to test them at the manufacturers works. To transport them they have to be disassembled and carried in small units.

To supply power to industry, 900 miles of three-phase transmission lines will be erected to the towns and to the Copperbelt area. Without power, industrial development would be difficult and slow as other fuels are scarce. However, cheap power alone is not expected to attract industry, for it is considered that the industrialist will demand the certainty of a regular and reliable supply even if this has a slightly higher charge. Although power is vital to the running of an industry it is not in itself a major financial item and it is estimated as only 1% in the case of textiles and just under 4% for the paper industries.

In March 1959, a 330,000-volt transmission system between Salisbury and Umniati was commissioned as part of a preliminary inter-connection linking Salisbury, Umniati and Bulawayo. This will come into service when power from Kariba is available. This line and its associated sub-stations form some 30% of the total transmission line.

In November 1959, the Federal Power Board issued in a statement that "power from Kariba should be available from January 1960. The first supply will go to the Copperbelt, followed as planned by supplies to Salisbury in mid-1960, to Lusaka and the Southern Rhodesian Electrical Supply Commission in its Central Area a few months later and to Bulawayo early in 1961".

The Zambezi in flood during 1958, the water is some 10 feet below the top of the coffer dam on the upstream side. Shortly after this photograph was taken the whole coffer dam was submerged.

(Photo : H.C. for Rhodesia and Nyasaland, London)

"When power from Kariba is lined with the existing coal-fired power stations owned by the public electricity supply undertakings, the Board, in accordance with the Electricity Act 1956, will become responsible for operating the inter-connected group stations so as to achieve minimum overall electricity production costs. The Board will pay the whole of the production costs and each undertaking will purchase its whole power requirement, including any part generated in its own stations, from the Board at the Board's Bulk Supply Tariff. The undertakings and not the Board will continue to distribute and sell power to individual consumers and to meet the costs of distribution."

The Board hopes to stimulate industrial and other development through the increased use of power and it is basing the cost of the Bulk Supply Tariff on this supposition. The initial tariff for the supply of electricity in bulk to Bulawayo, Lusaka, Salisbury and the Southern Rhodesia Supply Commission has been agreed with the individual undertakings and averages .8d per unit with, in addition, all increased demand over the amount now supplied (for 1959/1960) charged at £7 per kilowatt of annual maximum demand plus .1d per unit. (*continued on page 13*)

Information on Contracts awarded to British Firms in the Building of the Kariba Dam

Babcock and Wilcox Ltd.

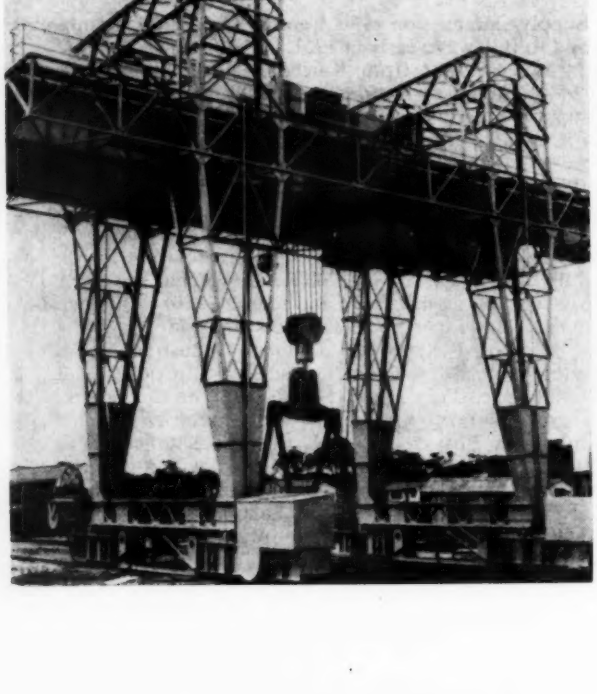
The Kariba hydro-electric scheme on the Zambezi river, will cost, on completion a total of £113,000,000 the aims of this vast project being to provide additional electric power for the rapidly developing African economy. The first stage of the scheme for an output of 500 MW is scheduled for completion by 1963 but power will be generated by the first machines in 1960.

Two underground power stations are being constructed, the first within the right bank and the second within the left bank of the Kariba Gorge. The first station with an overall length of 460 ft., will accommodate six turbo-generators and the second will have an equal or even greater capacity.

The construction and maintenance of such a large installation brings many problems in the handling of heavy plant, and it is not surprising to find that the equipment for one of the world's largest generating schemes includes some of the world's largest cranes.

These comprise the two 200-ton electric overhead travelling cranes in the first stage power house, and also the 100-ton Goliath crane for off-loading heavy equipment at the Lion's Den railhead serving the site which is distant by road some 120 miles. These cranes have now been built and installed by Babcock & Wilcox Ltd.

The Babcock Goliath crane which has a gross capacity of 107 tons. The crane rail centres 34 feet with cantilevers for side loading.



The first stage power house of the Kariba scheme has two four-motor electric overhead travelling cranes with a lifting capacity of 200 tons each, and an overall span of 63 ft. There is also an auxiliary hoist with a lift of 20 tons. The main hook can be used to a height of 65 ft., and that of the auxiliary hook to 68 ft. Should loads in excess of 200 tons need to be hoisted, then the two cranes are used in tandem with a lifting beam, to handle a gross load of 400 tons.

The Babcock five-motor Goliath crane at the Lion's Den railhead has a lifting capacity of 100 tons. This is a travelling crane, the span of the rails being 34 ft. The overhead structure with an overhang at each end has an overall length of 72 ft. It is equipped with a 15-ton auxiliary hoist and two motors for longitudinal travelling, the height of the lift for the main hook being 30 ft., and that of the auxiliary hook 33 ft.

Ferranti Ltd.

The transformer contract awarded to Ferranti Ltd by the Central African Federation Power Board in 1956 was the first to be placed in Britain for 330 kV, 3-phase transformers, and at that time, it was the largest contract for power transformers ever to be placed in Britain.

The contract was worth £1,241,000 and covered the supply of 2-120 MVA, 330/234 kV, 3-phase auto-transformers with separate boosters; 8-60 MVA, 330/88 kV, 3-phase double-wound transformers and 2-60 MVA, 330/33 kV, 3-phase double-wound transformers. All units will be provided with fully automatic on-load tap changing gear.

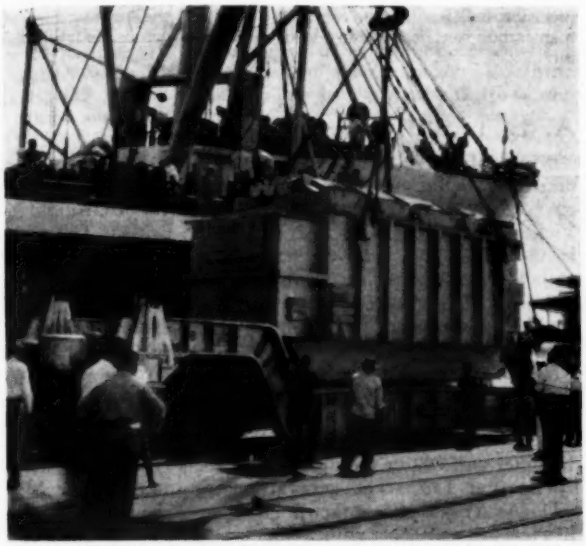
Special shipping arrangements were also required because of the necessity to off-load the units at Mozambique. In addition, the supply of two special rail wagons was included in the contract, each having ten axles so as to allow transport over the CPM and Rhodesia Railways systems from Beira and Lourenco Marques. These wagons were manufactured by Head Wrightson Teesdale & Co, Ltd.

The general scheme is designed to supply the Rhodesias, and in particular the Copperbelt, with power generated in the hydro-electric station at Kariba on the Zambezi River.

For the first stage, this station will be equipped with 6-100 MW sets and ultimately will have a capacity of 1200 MW. The generator voltage will be stepped up to 330 kV at the power station and transmitted at this voltage over distances up to 400 miles.

Ferranti Limited were also awarded a contract at the beginning of 1959 for summation metering equipment worth £47,000 approximately. Equipment comprises precision grade integrating meters, electro-mechanical summators, printometer demand recorders and suites of metering cubicles.

These equipments will be used to meter six 100 MW generator sets at Kariba Power Station and also the supplies to the transforming stations at Kitwe, Norton, Salisbury, Lusaka, Sherwood and Bulawayo.



60 MVA 330/33 kV 3-phase Transformer disembarking for installation at Kariba.

A two-element double disc type meter will be used throughout the scheme and it will be fitted with an outgoing 2-way impulsing contactor for the operation of electro-mechanical summators. The summators in turn, will operate Ferranti printometer demand recorders by impulses and they will also be arranged to provide impulses for telemetering purposes.

Provision will be made for the measurement of import and export flow of both kWh and kVARh, and for the wattful component, separate summators and printometers will be used. The leading and reactive power flow, however, will be measured on a new development, the Ferranti bi-directional summator. This device is capable of differentiating between leading and lagging reactive power flow for telemetering purposes.

Impulsing throughout the whole system will be at 50 volts d.c., the maximum rate of impulsing at full load being 66.2/3rd impulses per minute (=2000 impulses in a demand period of 30 minutes).

Ferranti feeder flow transmitters will also be employed on this scheme for the operation of the telemetering equipments.

A. Reyrolle and Co, Ltd.

The initial stage of this scheme consists of six major 330 kV switching stations at Kitwe, Lusaka, Sherwood, Norton, Bulawayo and Salisbury with a central hydro generating Station at Kariba.

The 330 kV feeders are protected by Reyrolle type-H distance protection a phase-fault relay and because of stability problems the distance protection is arranged to give accelerated tripping for 2nd stage faults by means of HF carrier signals transmitted over the power lines. A number of the distance relays are provided with in-built phase-selectors to operate in conjunction with single-pole high-speed auto-reclose circuit-breakers.

The voltage supplies to the distance protection are obtained from Reyrolle 330 kV capacitor voltage transformers and these units, where necessary, are equipped with line-traps which are used to inject HF signals over the power lines for protection and communication services.

Special system-stability relays of the type are fitted at all points to ensure that the distance protection does not mal-operate during conditions of system swinging, and if required these can be arranged to trip the circuit-breakers if the angle of swing becomes excessive.

Between Norton and Salisbury the feeder/transformers are protected by single-stage distance protection with coded carrier intertripping between the 88 kV circuit-breakers at Salisbury and the 330 kV circuit-breakers at Norton.

Leading power-factor relays are also fitted at certain points where it is possible for the lower voltage networks to attempt to supply the charging-currents of the 330 kV systems.

All of the above equipment was supplied by Reyrolle under a sub-contract from AEI (British Thomson-Houston Co, Ltd) who obtained the main contract for the 330 kV switchgear, but in addition Reyrolle supplied and installed, under direct contract, the equipment for controlling the auxiliary power-station. This comprised 11 kV metalclad switchgear with oil-break circuit-breakers of the horizontal drawout type, and the 380-volt metal-enclosed air-break switchgear also of horizontal draw-out design, together with the associated control and relay boards.

System stability relays supplied by A. Reyrolle and Company, Ltd.

British Thomson-Houston Co, Ltd.

The British Thomson-Houston Export Company have been awarded the contract, valued at over £2,000,000, for the whole of the 330 kV switchgear for the Kariba Hydro-Electric Scheme of the Federal Hydro-Electric Board, Federation of Rhodesia and Nyasaland, with Merz and McLellan as consultants.

The order covers six complete 330 kV sub-stations located at Kariba, Kitwe, Norton, Sherwood, Salisbury and Bulawayo, incorporating twenty-three oil circuit-breakers. There is also to be a switching station at Lusaka.

The order is one of the largest switchgear contracts ever secured by a British firm, and is among the first orders placed in Britain for 330 kV swithgear.

The 330,000-volt circuit-breakers included in the contract are a direct development of those installed by BTH on the British 275 kV Super Grid and are of the bulk oil type having lenticular tanks and including six breaks per phase, shunted by switching resistors.

Richard Costain Ltd.

Richard Costain Ltd have built the Kariba Township which accommodated the people constructing the dam. The whole town was built in 15 months and includes hospitals, Schools, Churches and all the roadways, drainage and other necessities. The town can accommodate 8/10,000 people and cost about £3½ million.

Herbert Morris Ltd.

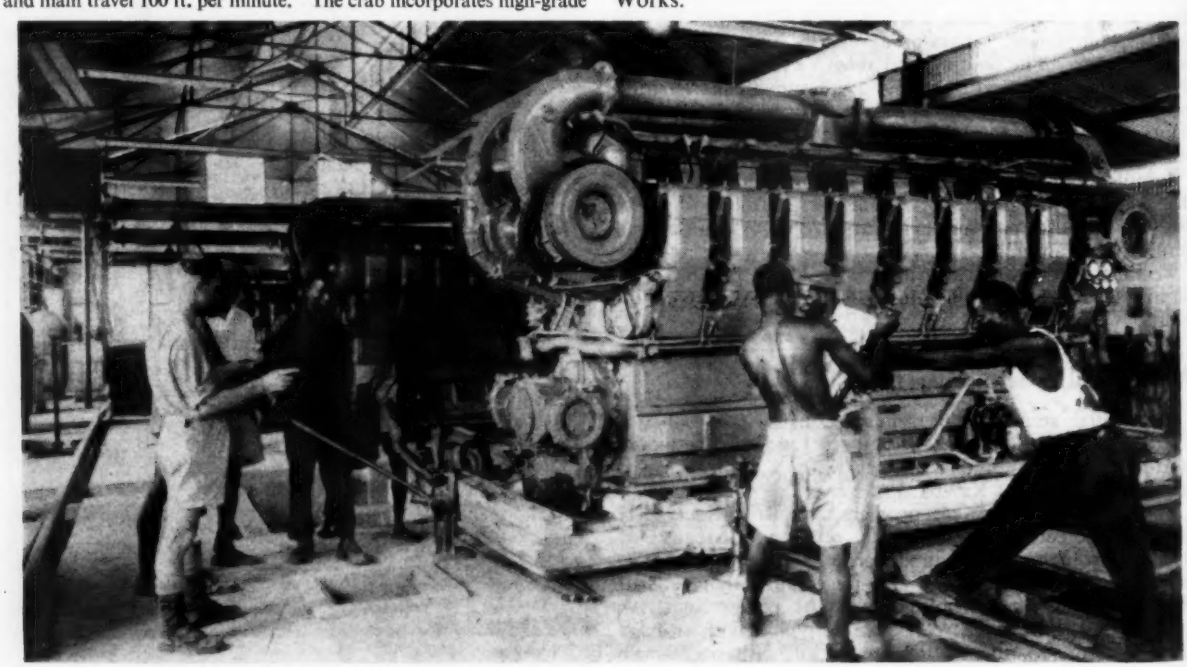
Herbert Morris, Ltd have supplied a Morris 30-ton Electric Overhead Crane with fish belly box girders having a span of 50 ft. Approximate speeds are main hoist 30 ft. per minute, cross traverse 50 ft. per minute and main travel 100 ft. per minute. The crab incorporates high-grade precision ball bearings on which are mounted the hoisting gears of high carbon steel enclosed in a gear-box which contains the lubricating oil.

A. E. I. Ltd.

Most of the electrical equipment for this vast undertaking is being made in Britain and the major part is covered by contracts originally placed with Metropolitan-Vickers Electrical Co, Ltd and The British Thomson-Houston Co, Ltd, whose overseas interests are now dealt with by Associated Electrical Industries Export Ltd. The six 100 MW generators for the initial stage of the project are being supplied by the AEI Heavy Plant Division, Manchester, the 330 kV switchgear by the AEI Switchgear Division, Willesden, and certain of the electric cables by another AEI Company, Siemens Edison Swan Ltd.

Each of the generators, which will be among the largest of their type in the world, weighs 720 tons, is 40 ft. in diameter and will be coupled to a Francis-type turbine made by Bovings Ltd. The generators are rated at 100 MW (111 MVA) 0.9 power factor lagging, 18 kV, three phase, 50 cycles, speed 166.7 rpm. The vertical shaft is fitted with a thrust bearing and one guide bearing positioned immediately below the rotor. Excitation is provided by a 364 KW, 360 V, d.c. machine fitted to the generator and controlled be a rotating magnetic amplifier type coltage regulator.

Auxiliary equipment includes built-in fire fighting equipment initiated by thermostats in the hot air circuit, high pressure oil operated rotor jacking system, governor and bearing oil purification equipment, air compressor unit for braking, and the transformer cooling water system. The first generator was fully tested at the AEI Trafford Park Works.



An English Electric 1100 kW 16 SV diesel alternator sets being installed in a temporary power station at Kariba.

Cementation Co. Ltd.

In December 1951 the Government of Southern Rhodesia awarded a contract to the Rhodesian Branch of the Cementation Co (Africa) (Pty) Ltd for exploratory drilling in the Kariba Gorge of three possible sites for the proposed dam, the contract to commence in May 1952.

Site X having been selected, it was essential to get the cofferdam foundations completed before the rainy season as otherwise progress on the dam would have been held up for one year. On the strength of their knowledge and specialized experience at Kariba The Cementation Company were awarded a contract by the Federal Power Board for the preliminary works in June 1955.

This contract, valued at £1,600,000, included the diversion tunnel, diversion channel, North Bank cofferdam, site roads, workshops, stores, camp and other ancillary buildings.

The diversion tunnel, 1,200 ft. long and 35 ft. x 40 ft. in section, was completed except for the stop ends when the main contractors for the dam started work in August 1956. By this date 800 ft. of diversion channel, involving 100,000 cu. yds. of rock excavation, had also been completed.

The foundations for the North Bank cofferdam were completed to river level. This cofferdam was to be a thin shell concrete arch with a developed length of 1,000 ft.

Specialist Works carried out as a Sub-Contract.

The sub-contract awarded to the Cementation Company Ltd by Impresit, the main contractors, consisted of drilling and grouting the main dam cut-off curtain and contact treatment, the intake grout curtain, contraction joint grouting treatment of underground structures and construction in Colcrete of the main circular cofferdam foundations.

Intake Grout Curtain.

The intake grout curtain is situated along the gate operating platform at RL 1606. This platform houses the tops of the six penstock shafts and the machinery for operating the radial gates situated at the intake levels in each of the shafts. The intake grout curtain serves two purposes—(i) the area in front of the penstock shafts required a temporary curtain to prevent the water in the lake seeping through the badly fissured quartzite in this area thus preventing the successful concreting of the penstock shafts; (ii) in order to join the main dam cut-off curtain with the grouting around penstock No 1, it was necessary to form a permanent curtain from penstock 1 to joint 38 on the main dam.

Underground Cementation.

The following brief description of the underground section of the works will give some indication of the amount of underground cementation required. The purpose of the cementation was to render the structures watertight and to strengthen the rock where necessary.

The underground works are situated upstream of the dam on the South Bank approximately 600 ft. below ground level. This underground station will accommodate six vertical shaft Francis turbines, each with an output of 140,000 hp coupled to an alternator with an output of 100 mw. The transformers are also housed underground adjacent to the Machine Hall, the switch yard and control room being located on the surface 600 ft. above the power station.

Machine Hall.

460 ft. long x 80 ft. wide x 120 ft. high, this will contain 6 turbines and alternators.

Roof and side walls are concrete. Grouting of the vault was carried out from mobile gantries running on the wall beams constructed for 200-ton cranes to be installed later. Afterwards one of the cranes was used. For grouting of the south and upstream end wall of the machine hall, some 10,000 ft. of scaffolding had to be erected.

The north sidewall was further strengthened by post tensioning by means of high tensile steel cables placed in holes drilled through to the face of the wall from the adjacent and parallel-running gallery. The cables were grouted after tensioning.

Transformer Hall.

Positioned 60 ft. south of and parallel to the Machine Hall this hall is 550 ft. long, 60 ft. wide and 45 ft. deep. Six transformers will step up the voltage to be transmitted to 330 kv.

Draft Tube Outlets.

The draft tube steel liner of each turbine is connected to the surge chamber and tailraces by a concrete-lined tunnel, rectangular in section, called a Draft Tube Outlet.

The concrete lining contains heavy reinforcement and grouting was carried out through preplaced pipes.

Gate Erection Chamber.

This chamber contains the gate for the closing off of the draft tube outlets from the tailrace tunnels when the turbines are not running. (The level of the river downstream of the dam is expected to be 40 ft. higher than that of the invert of the tailrace and draft tube outlets.) This chamber is 60 ft. long x 30 ft. wide x 40 ft. high. Some 4,000 ft. of scaffolding was erected in order to carry out the grouting.

Main Access Gallery.

This tunnel, 850 ft. long x 20 ft. wide with a maximum height of 20 ft., will provide permanent access for heavy vehicles carrying out maintenance and repair work. All heavy machinery for the power station is brought in through this tunnel.

Ventilation Gallery to the Surge Chamber.

This gallery is designed to act as a "breather" during the rise and fall of the water in the surge chamber.

Surge Chamber.

For each pair of machines there is an underground outlet surge chamber to control the surges in the outlet tunnel. The chambers are 63 ft. in diameter and 160 ft. high. They had to be grouted after lining and owing to the large amount of scaffolding required, the perimeters were grouted in three stages. Even so, 10,000 ft. of scaffolding was required for each stage.

Diversion Tunnel Plug.

Prior to impounding in December 1958 the diversion tunnel had been plugged off just upstream of where No 3 tailrace joins this tunnel. The position coincides approximately with the access of the dam. The plug, which is approximately 40 ft. in diameter, was treated by four stage grouting.

Cable Shaft.

The cable shaft, 20 ft. in diameter, will carry the cables from the transformers underground to the switching station on the surface. It is connected to the transformer hall by a small gallery running from the upstream end wall.

Temporary and Permanent Intakes.

Horizontal tunnels, 16 ft. wide and 20 ft. high, rectangular in section, carry the water into the penstock shafts. In order to have initial generators in January 1960 two low level temporary intakes have been constructed leading into shafts 1 and 2. This has been necessary as the level of the lake will not have reached the permanent intake level for these machines.

(*continued from page 9*)

In February 1959, the estimated cost of power to be delivered to the grid from Kariba was given in the Federal Parliament as:

1961	.869d per unit
1966	.464d per unit
1969	.342d per unit
1972	.283d per unit

This represents the costs of construction, transmission, depreciation, and an additional provision for the redemption of loans.

The power from Kariba will more than double the current output of the Federation and will make possible an increasing development in industry through the availability of cheap power. It is, however, more than just another hydro-electric project. It is a monument to the achievement of modern civil engineering under the most difficult and hazardous of conditions.

Western Nigeria's Production Development Board

THE WESTERN REGION PRODUCTION BOARD, was established in 1951. with funds initially derived from surpluses of the Cocoa and Oil Palm Marketing Board.

An additional sum of £3.7 million was recently earmarked for use by the Production Development Board in furthering the Western Region's government overall £115 million economic five-year programme. This means that the Board has a total capital of nearly £15 million.

The Board was set up originally to assist the development of the economy of the Western Region, and has both agricultural and industrial functions. In agriculture its object is not only to make the economy of the region less dependent on the largest export crop, cocoa, but to demonstrate the superiority of agricultural methods conducted on scientific plantation lines. During the past seven years it has contributed largely towards the development of plantation management in the Region by establishing plantations of oil palm, cocoa, citrus, pineapples and rubber covering over 35,000 acres in various parts of the territory.

Three types of plantations have been developed. The first group consists of the plantations directly owned by the Board such as the 13,000-acre Ijebu Farm Project producing palm-oil, cocoa, citrus and coconut; the 26,000-acre Upper Ogun cattle and sheep ranch and cashew plantation; the 7,800-acre Araromi Rubber Estate, the 4,000-acre Urhonigbe Rubber Estate and the 1,000-acre Oda-Akure Cocoa Plantation. In all these projects the Board has leased the land and provides its own management and labour.

The second group consists of partnership schemes. These include the Igueben Oil Palm Partnership project in Ishan Division, the Owo Coffee Partnership project, the Araromi Oil Palm Partnership project in Ondo Division, the Asejire Partnership project which produces cocoa, oil palms and citrus in Oshun Division, and Apipititi Co-operative Plantation Partnership which grows cocoa and citrus in Abeokuta Division. Some 7,000 acres of plantation crops are farmed in partnership with co-operative societies and local interests. In all these partnerships the Board farms and land is provided by the partners.

Not only are these projects designed as sound financial investments but their establishment is one of the means by which the Board is able to demonstrate in practical ways methods of improving the agriculture of the Region, and of showing to farmers the advantages of modern plantation methods.

Already the projects are bringing increased prosperity to the various localities in which they are situated by providing large numbers of men and women with opportunities for earning a good livelihood.

The third type of plantation is one in which the Board is joined by financial and technical partners. The 8,600-acre Ilushin Rubber Estate has been established in this way. The capital is jointly provided by the Production Board, the Colonial Development Corporation and the West African Joint Agency Limited. There is considerable scope for other financial and technical partners to establish similar plantations on this basis in the near future.

The current acreages of the major crops established by the Board in its various plantations, revealing the magnitude of the Board's efforts in the field of agriculture, are listed below:

	Acres
Oil Palm . . .	10,840
Citrus . . .	1,780
Cocoa . . .	4,100
Rubber . . .	7,500
Coffee . . .	480
Cashew . . .	1,000

The progress made in all the plantations has been extremely encouraging. The importance of the Board's agricultural projects lies not only in their size and variety (they represent a capital investment of over £6 million) but also in that they show the Board's contribution to the diversification and improvement of the Region's agriculture.

Although agriculture is the most important feature of Western Nigeria's economy, the vital role which industry can play in the development of a modern nation has also been recognized.

The production Board has already established a number of industries in the Western Region. In the capital Ibadan alone, the Board is associated with two large industrial undertakings, the Lafia Canning Factory and the Nigerian Plastics Company.

The Lafia Canning Factory, entirely owned and operated by the Board, is one of the most modern of its kind, and was built at a cost of about £450,000. The quality of the factory's many products is highly regarded at home and overseas, and the Board is currently seeking foreign financial and technical participation in this project to expand and extend production.

The Nigerian Plastics Company is a tripartite venture. The three shareholders are the Board, which has 50% of the shares, the United Africa Company Limited, 35% and the Yorkshire Imperial Metals Limited, 15%. This factory, which was opened in March 1959, produces polythene tubes, plastic buckets and basins and sundry plastic materials.

The Nigerian Industrial Domestic Gas Supply Company Limited is another joint venture with private capital, and in this case the Board has an equal stake with Italian interests. This company imports and distributes liquefied petroleum gas for cooking and lighting purposes.

In establishing new industrial projects, the Board is anxious to ensure sound planning and efficient management and it enters into negotiations with partners who are not only able to supply the technical know-how, but who are also willing to participate financially in the venture.

The Board does not insist on holding controlling interest in industrial partnership projects. Each new project is considered on its merits, taking into consideration the views of potential overseas partners.

A £4½ million cement factory is now under construction at Papalanto. The Board holds only 39% of the shares while the Associated Portland Cement Manufactures Limited own 51% and the United Africa Company 10%.

Similarly, Crittall Manufacturing Company Limited and John Holt & Co (Liverpool) Ltd, have a majority interest in Crittall Nigeria Ltd, a £100,000 factory at Mushin making metal window and door fittings, in partnership with the Board.

The Western Region Production Development Board has also set up a £300,000 rubber processing factory at Benin which produces crepe rubber at the rate of three tons a day.

The Lafia Rest Centre in Ibadan, Nigeria's most modern catering rest house, is another venture owned and operated by the Board. The Board also operates many palm-oil and rice mills and has allocated nearly £1¼ million for the construction and improvement of roads.

During the seven years of its existence the Board has made considerable progress. In particular, it has achieved much success in attracting outside partners to participate in a variety of undertakings which not only helps the economy of the Region but provides more and varied employment opportunities for the people.

The Western Region Production Development Board is currently negotiating with foreign interests on a number of projects but ample scope for new investment still exists. The Board is particularly interested in establishing such industries as textiles, matches, paper, flour milling, iron and steel, asbestos cement, tyres and tubes, quarrying and ceramics.

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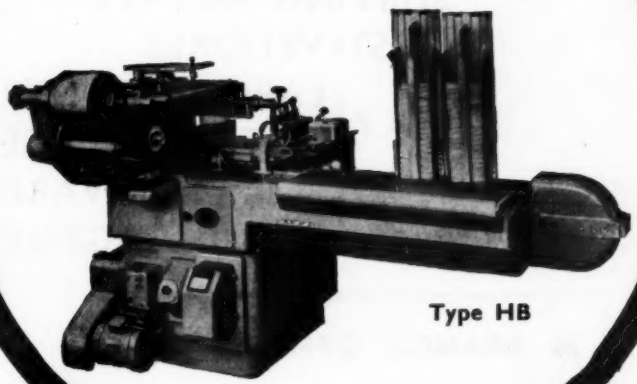

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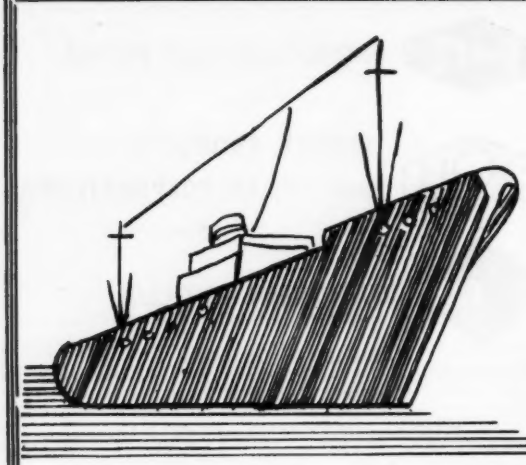

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